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ABSTRACT

This paper describes cost models designed to aid schools in effective cost planning through analysis of the relative costs and benefits of individualized, computer-based instruction. The models are then applied to the Individualized Study by Technology (IST) program of the Alaska Department of Education (DOE) using data obtained in a pilot study of four microcomputer-based high school courses at 24 rural school sites in Alaska during the 1980-81 school year. Illustrations include the analysis of DOE and local site costs for the pilot study; prediction of costs of expanding the number of courses, sites, and students that will use the materials; and comparison of the costs and benefits of the multimedia program to traditional methods. The conclusions presented indicate that, on the basis of costs, offering computer-based instruction is preferable to more traditional, teacher-based instruction, but that the computer-based program did not produce better learning. Data related to the models and the IST evaluation are displayed in six tables and eight figures, and eight references are listed. (LMM)

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MODELS FOR ESTIMATING COSTS OF COMPUTERIZED INSTRUCTION

September, 1982

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Microcomputers are becoming standard instructional media options in educational programs. A major reason for this is that they are remarkably inexpensive for what they can do. Further, they are becoming very accessible. Department stores and neighborhood computer stores offer low-cost microcomputers to shoppers who can test the machines and see them operating. In addition, the operation of these machines has become simplified enough so that a student in a classroom can operate one with little or no supervision. Although computer prices have dropped, it has been shown that even a free-computer can be expensive if the programming, maintenance, and operational costs are considered (Lemos, 1981). School administrators and planners must have methods of determining whether implementation of computerized instruction is preferable to other approaches on the basis of cost.

Although analysis of costs of educational programs has been attempted before, such study is fraught with difficulty (Bramble, Ausness, & Mertens, 1975; Jamison, Klees, & Wells, 1978; Thompson, 1980). This is true partly because costs are often not readily translatable into dollar terms. For example, educational programs involve "human costs" (i.e., feelings, values, priorities, etc.), time, space, skill and talent resources, and other kinds of costs that are not easily reduced to dollar amounts for traditional cost analysis. This has led to the suggestion that traditional cost analysis can not be appropriately applied to educational programs

(Thompson, 1980). Siedel and Wagner (1979) have emphasized the cost-effectiveness approach to computerized instruction, while others have focused on the actual dollar costs of such programs (e.g., Bramble, et. al., 1975; NWREL, 1981). Despite the inherent difficulties in demonstrating savings or benefits of computerized instruction, benefits of computerized delivery of individualized instruction has been documented (Kearsley, Hillelsohn, & Seidel, 1981-82; States, 1980-81).

There are two kinds of actual dollar costs in educational programs, each requiring separate identification in a cost analysis. The first involves one-time expenditures such as capital outlays for equipment and development or purchase of software. The second kind is recurrent or continuing costs. Usually, costs that will appear in more than one fiscal year are considered in this category (Jamison, et. al., 1978). It is generally thought to result in more accurate per year cost estimates when pro-rated portions of one-time or capital expenditures are assigned to each year of the life of a project or program. For example, if a tape recorder is purchased in the first year of a four year project for $100.00, it will be charged to each of the four years at the rate of $25.00 per year.

The present paper describes cost models which can be used by state and local school administrators to estimate the costs of furnishing computer-based education. The models were designed to provide the opportunity for deletion of any of the factors depending on whether or not tney were present in a specific situation. Since quality of learning does not translate easily into dollar amounts, such questions were not addressed in the present study.

The Models

Figure 1 shows the overall model for computing per year costs of educational programs for state and local school planners. This model was further specified for one-time and continuing costs in Figures 2 and 3 for the state and local levels respectively.

Insert Figure 1, 2, and 3 about here

The models depicted in Figures 2 and 3 could be further analyzed in terms of the costs of various media options such as printed materials, audio cassete tapes, videotaped portions, and finally computer-related costs. This permits the development of ratios for comparison of relative costs of media options within the educational program.

An Illustration of the Models

An example of the application of this cost model approach to cost study is taken from the Individualized Study by Technology (IST) program of the Alaska Department of Education using data obtained in a pilot study with four microcomputer-based courses. THe pilot study was conducted at 24 rural school sites across the state during the 1980-81 school year. The IST program was initiated by the Alaska Department of Education (DOE) to make high quality secondary school level educational courses available to isolated rural locations in Alaska. Students at these locations might not otherwise have this kind of educational opportunity. The courses utilize a complex individualized instructional design which includes audio cassette tapes, traditional text and printed materials, and

microcomputer-managed/aided instruction.

The bases for cost estimates in this report are the costs assumed by the Department of Education (DOE) for one school year (1980-1981) summarized in Table 1 and those assumed by the local schools in the same year displayed in Table 2. These data were furnished by the Director of the Educational Telecommunications for Alaska (ETA) Project at the end of the 1980-81 academic year.

Insert Tables 1 and 2 about here

The several assumptions underlying the cost models in this report can be summarized as follows:

1. In computing cost components, a weighting system was devised based on the approximate expenditures involved in each component as reported by the director of the program. These weightings were:

a) Print materials - 57% of total program
b) Audio component - 17% of print component
(or 10% of total program)
c) Computer component - 50% (print + audio)
(or 33% of total program)

These weightings result in the printed and audio portions of the courses, the most traditional parts, together constituting two-thirds of the costs. The computer portion accounted for the remaining third. Other projects and programs with different requirements, goals and settings may produce different weightings. However, for planning purposes these weightings might be useful.

2. Amortization schedules assumed four year usable life of all course components and equipment, except tapes and diskettes (for which a two year life was assumed), and consumable supplies.

3. In the projection of costs for 600 students per course (see Table 6), it was assumed that typically about six students would be taking each course at a site. Therefore, all computations were based on six students per course at each of the 100 sites.

4. Since overhead costs would be present for physical plant, heating, phones, etc. in any case, only those costs that were uniquely attributable to the IST Program were included in the present study.

5. One half of the cost of each cassette tape recorder was attributed to IST since tape recorders are also used in other classroom activities.

6. Teacher costs (including salaries, benefits, travel allowances, etc.) were not included in the cost models except for those related to IST teacher-training. It was assumed that such costs are part of overhead costs in any educational program, similar to building, utility, and maintenance service costs, and were not unique to the IST courses.

7. Inflation was not considered. Therefore, the present models reflect a constant dollar value for amortization of costs.

Cost Models for the IST Program

Cost models developed for the IST Program based on the pilot study are displayed in Figures 4, 5, and 6. The major analyses in the present report are predicated on these models. Explanations of them are given below.

I. Cost of Offering IST Courses at Each Site

The cost of offering each course at a rural site is based on the following:

* Number of IST courses to be offered.
* Equipment costs (purchase and maintenance)
* Teacher training
* Number of students enrolled to take the course
* software and courseware costs
* Costs of consumable and non-consumable classroom materials.

The costs of offering one, two, three, and four courses at a local site ave been computed using the model shown in Figure 4 and are shown in Tables 3 and 4. Table 4 shows the full one year cost of offering an IST course to six students including annualized hardware costs, the local district portion of teacher-training costs, and so on. (Hardware for the IST program included a 48 K Apple computer, 3 disk drives, a clock-calander card and a cassette tape recorder.) The entries in Table 4 can be compared with those in Table 3 which do not include hardware costs.

It can readily be seen that the Alaska History course is the

most expensive to implement. In fact, any pair of the other courses could be implemented for about the cost of the course in Alaska History. Further, if the Alaska History course is used with two other IST courses, the fourth can be implemented for less than 20% additional cost (from Table 4). Therefore, some efficiency is realized by using more than one of these complex multi-media courses at one time in a school. For example, it is estimated that one Apple II microcomputer can service six to eight students simultaneously taking two courses. Three courses can also be managed with one computer and some careful scheduling by the teacher. However, the courses were supposedly designed to be student-directed as much as possible. Therefore, an additional computer might be desired if three or four courses are each offered to six to eight students. The cost picture would be more favorable to IST if the computer(s) is(are) used to meet needs outside of IST as well. No such applications of computers were assumed in the present analyses.

Insert Figure 4 and Tables 3 and 4 about here

II. Cost of printed ortion of each course

The model used for computing the costs of the printed portion of each course that are attributable to DOE and each site is shown in Figure 5. The printed portion of the courses consisted of all manuals, texts, workbooks, supplementary readings, teacher's guides,

unit tests, etc. These materials alone would represent a fairly complete set of course materials in traditional classroom settings.

Using this model, costs of the print materials for each course were computed for the pilot study. These costs are displayed in the first section of Table 5. The first section of Table 6 shows the costs for future implementation of IST printed materials with 600 students.

Insert Figure 5 and Table 6 about here

III. Cost of printed and audio components of IST

Figure 6 shows the cost model depicting the addition of the audio component to the printed component of IST. Basically, what is added to the DOE portion is the additional cost of producing the audio cassette tapes. Additional costs to the local sites include the portion of the classroom sets that involves the audio component, that is the tapes, and tape recorder. Tape costs were spread over a two-year period of assumed useful life. Tape recorders and other audio component expenses were amortized over four years.

Insert Figure 6 about here

Table 5 shows the increase in costs for each course caused by

the addition of the audio component in FY81. Table 6 displays costs of offering IST with printed and audio components to 600 students. It can be seen that the increased media costs are proportionately about equal for the local site and DOE.

IV. Cost of full IST course (print, audio, and computer)

Figure 7 shows the cost model depicting the addition of the computer component to the printed and audio components. Basically, what is added to the DOE portion is the additional cost of developing the computerized instruction. Added costs to the local sites include the hardware and software needed to implement the computer component. Diskette costs were spread over a two year period of assumed useful life. Computers and other component expenses were amortized over four years.

Table 5 shows the increase in costs for each course by the addition of the computerized component, while Table 6 displays costs of offering IST with printed, audio and computer components to 600 students. It can be seen from Table 5 that DOE bears a larger portion of the actual cost increase when computerized instruction is added to the program. However, the computer addition represented a larger expenditure proportionately for the local sites.

Conclusions From the IST Experience

Figure 8 shows the curves of the change in costs per student to DOE and the local sites as the IST Alaska History program is taken by more students. The Alaska History course was used to demonstrate the cost patterns in this analysis, however, the patterns would be similar for the other courses. It can be seen in Figure 8 that while site costs remain fairly constant with increasing numbers of

students, DOE per-student costs reduce markedly. The reason for the reduction in DOE costs is that these costs are primarily associated with development. On the other hand, site costs per student increase slightly primarily because of additional equipment, teacher training, and classroom sets. Further, beyond 600 students, the per-student costs remain steady for the local sites, and do not change markedly for DOE.

Another important factor to remember is that site costs are largely continuing. These costs involve purchase of student sets, maintenance contracts, consumable supplies, and teacher training, while those for DOE are primarily one-time development costs. Therefore, site costs will be more subject to inflationary changes within a four year amortization schedule.

A further analysis was done to estimate the per-student costs for a full-time IST program. For the purpose of this analysis, six courses were considered a full program for a student. This would allow for five required academic subjects and one elective per semester (two semesters per year). Based on an average of $416 per IST course (average of per student cost from Table 6, column b+d for full course), six IST courses would require $2496. The site contribution would be about $1260 per-student (at pilot-study prices, assuming about $210 per course). This is well within the approximately $6919 per average daily membership (ADM) per-student received by rural districts from the State in the 1980-81 school year, the year of the pilot-study, and leaves $5659 to be applied toward other local school needs.

It is instructive to note that that there were three types of

approaches to course development tested in the pilot study. The first was represented by the Alaska History course. This course was tailor-made for use in Alaskan secondary programs. For this subject matter, there was very little in the way of existing educational curricula from which to draw. Although a list of published supplementary material was developed for use with the course, virtually all educational texts and activities had to be developed within the IST program. This distinguished the Alaska History course from two other IST courses first in the pilot test, General Math, and Developmental Reading. These courses were based on existing texts and course materials available from publishers. The third kind of approach was taken in development of the IST English course. This course was fairly standard scope and sequence for English courses but was almost entirely developed within IST, and was not based on a commercially available textbook. In terms of a full utilization with 600 or more students, the last approach would seem on the surface to be more cost efficient (see Table 6). However, caution should be exercised in comparing these developmental approaches. That is, development costs are probably somewhat dependent on the material being presented. For example, the media options used in language instuction might cost less to develop than those in mathematics. Further, the costs of expert consultation probably varies from one academic subject to another. Finally, the English course was developed about a year and a half before the General Math and Developmental Reading courses, and production may appear cheaper due to inflation. Thus, although little can be said on the basis of small differences about the relative cost-benefit of the approaches, if all considerations were equalized, the Alaska History course would

probably still be the most expensive. This suggests that development of a new course for which there is no precedence or previously determined structure would be considerably more expensive than a more established course.

It can be seen from Tables 5 and 6 that in each case, the complete course with full media options cost about twice as much as the print materials alone. Since the printed portions of the courses are comparable to a traditonal set of curriculum materials, its cost can be used as an approximation of traditional course materials. Using this approach, the cost of offering these courses by hiring additional teachers who are qualified to teach in the appropriate secondary school content areas with the printed materials can be compared to the costs of offering these courses through the full media IST model.

It is conservatively estimated that in the 24 pilot study sites, approximately 20 additional teachers would have been required to offer the IST courses if the full media model and individualization were not present. Assuming that a teacher costs an Alaskan school about $40,000 including travel, benefits, and salary, an additional $800,000 for teaching would have been spent. Adding this to $255,274 which is the total cost of the printed component of the IST program's four courses (see Table 5, sum of column a+c) would yield a grand total of $1,055,274. On the other hand, the total cost of offering the courses with the audio and computer portions to the 367 enrollees was $550,030. This results in a cost-benefit ratio of:

Costs without audio and computer + 20 additional teachers

Costs with audio and computer as offered in Pilot Study

$$= \frac{1,055,274}{550,030} = 1.92$$

In other words, for the 367 students participating in the pilot study conducted on the four IST courses, the full-component model was nearly one-half the cost of similar courses offered without the media options but with additional teachers. These approximations cannot be applied to any particular site since some sites would not require additional teachers, while others would need two or more.

A further analysis was done on on the hypothetical implementation of IST at 100 sites with six students per site described in Table 6. Using the same ratio of 20 additional teachers required for 24 sites, it is estimated tha the the 100 sites would be required to hire 83 additional teachers. At $40,000 per teacher, that would result in an expenditure of $3,320,000 for teachers. Adding this to a total of $509,363 for print materials for the four courses yields $3,829,363. The full IST implementation with no addtional teachers would be $998,654. This results in a cost-benefit ratio of:

$$\frac{3,320,000}{998,654} = 3.32$$

Thus, the cost-benefit is roughly three to one, or to put it another way, offering IST courses in the traditional manner without individualized computer and media based instruction would cost about three times as much as the IST courses. Other studies have tended to show favorable cost ratios for computerized instruction (e.g., Kearsley, et. al., 1980-81; States, 1980-81; Sojka, 1981).

It should be stressed at this point, that the teacher is an important component of the IST model. The findings of this report do NOT support replacing teachers with IST. The courses were designed to be managed by teachers who may or may not be qualified to teach in the particular academic subject area in which a student requires instruction. These courses must be managed by classroom teachers, however. Therefore, the results suggest that individualized computer-based instruction may be a more economical way to offer small groups of students remedial or low enrollment academic courses. Further, the use of these courses can free the teacher to do more individual work with a given child. However, it should be recognized that a classroom teacher is required to monitor, organize, administer, and maintain these complex media packages. The value of the of computer-based complete self-directed instructional packages is that the teacher is freed from some organizational and developmental duties to work with students on an individual basis in the class. The availability of such course packages may provide flexibility in staff planning while offering diversity of available instruction to students.

Conclusions

The purpose of this paper was to develop cost models that could be used to study the costs of offering computerized and multi-media instruction. The models were applied to the IST program of the Alaska Department of Education. Illustrations included the analysis of DOE and local site costs for the pilot study of four courses, prediction of costs of exanding the number of courses,sites, and students that will use the materials, and comparison of the costs and benefits of the multi-media program to traditional methods. It should be recognized that the complex issue of quality of learning was not considered in this paper. Therefore, while it was shown that on the basis of cost, offering computer-based instruction was preferable to the more traditional teacher-based instruction, it was not shown that the computer-based programs produced better learning. By effective cost planning, schools should be able to better analyze the relative costs and benefits of individualized computer-based instruction. The cost models presented in this paper should be helpful in that planning.

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TABLE 1

ALL COSTS TO THE DEPARTMENT OF EDUCATION FY81

(Amortized from previous and present years where appropriate.)
(All figures rounded to nearest whole dollar.)

1.	General Administrative Overload	
	a. Development and evaluation (4 year amortization)	$ 11,250.00
	b. Development carried over from previous years	18,750.00
	c. Printing and direct support, etc.	95,000.00
	Total Administrative	$125,000.00
2.	Administrative Site Support	
	a. Hardware/software consultation	$ 12,000.00
	b. On-going site support (Regional Supervisors)	143,000.00
		$155,000.00
3.	Site Visits (average 2.5 days x 29 sites)	
	a. Travel costs (@ $400.00/site)	$ 11,600.00
	b. Contractor/staff (@ $375.00/visit)	10,875.00
		$ 22,475.00
4.	Midyear Meeting	$ 19,000.00
5.	IST Development Costs	
	a. Total evaluation for FY81 (includes carryover from previous years and amortized FY81 costs for development, field support, programmer and computer facilities)	
	FY81	$ 54,000.00
	Previous years	30,000.00
	Total FY81 evaualtion costs	$ 84,000.00

b. IST Software development	
1. Version 1.0 (190,000.00 over 4 years)	$ 47,500.00
2. Enhancements (50,000.00 over 2 years)	25,000.00
	$ 72,500.00
c. Basic IST Model (carryover)	$ 75,000.00
d. DOE overhead carryover for development	$ 25,000.00
Total FY81 development costs	$256,500.00
6. DOE Training Costs	
Pre-service workshops and training of supervising teachers	$ 56,000.00
7. Course Materials Development	
(Amortized over 4 years estimated useful life. Costs shown are for the 50 classroom sets and 200 student sets per class delivered by the developer.)	
a. Whole course less diskettes (including carryover from previous years)	
Alaska History	$ 44,500.00
English	24,500.00
Developmental Reading	29,000.00
General Math	29,000.00
U.S. History	30,750.00
General Science	30,750.00
Total development costs attributable to FY81	$188,500.00
b. Pilot testing of courses (including from previous years)	
Alaska History	5,500.00
English	5,500.00
Developmental Reading	6,000.00
General Math	6,000.00
U.S. History	6,250.00
General Science	6,250.00
Total pilot testing cost attributable to FY81	$ 35,500.00

c. Diskettes - FY81 (Amortized over 2 years)

Amortized actual FY81 diskette costs	$ 1,983.00
Carryover from previous years	248.00
Total amortized FY81 diskette costs	$ 2,231.00
TOTAL DOE COSTS (including amortization for FY81)	$860,206.00

TABLE 2

COSTS APPLIED TO THE LOCAL SITES FY81

(Includes amortization)

(FY82 diskette price 3.25-amortize over 2 years)

(All figures rounded to nearest whole dollar.)

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1. Teacher Training (at 1.5 IST teachers per district) (2.0 years amortization based on average tenure at a site)

	Per site	$ 1,088.00

2. Materials Costs

Assuming: 1) 6 students per district
2) diskettes amortized over two years
3) non-expendable courseware life 4 years
4) expendable items are replenished

a. General Math

Classroom set less renewable (per year)	$	54.00
Consumable classroom items		18.00
Student Sets (@ $34.00 x 6)		204.00
Price per site FY81		276.00
Complete set of diskettes ($56.00)		28.00
Price per site FY82	$	304.00

b. Developmental Reading

Classroom set less consumables (per year)	$	76.00
Consumable classroom items		10.00
Student sets (@ $24.95 x 6)		150.00
Price per site FY81	$	236.00
Complete set of diskettes ($56.00)		28.00
Price per site FY82	$	264.00

c. English

Classroom set less consumables (per year)	$	69.00
Consumable classroom items		12.00
Student sets (@ $25.58 x 6)		154.00
Price per site FY81	$	235.00
Price of set of diskettes ($56.00)		28.00
Price per site FY82	$	263.00

d. Alaska History

Classroom set less consumables (per year)	$	82.00
Consumable classroom items		15.00
Per student (@ $67.61 x 6)		406.00
Price per site FY81	$	503.00
Price of set of diskettes ($49.00)		25.00
Price per site FY82	$	528.00

3. Hardware Costs (amortized over 5 years)

a. Computer hardware (@ $3500.00/set)	$	700.00
b. Tape players, earphones (½ usage for IST @ $100.00 x 2)		20.00
c. Power protection (@ $350.00/unit)		70.00
d. Maintenance average per year		400.00
	$	1,190.00

TABLE 3

AMORTIZED PRICE PER SITE FOR 1,2,3, AND 4 IST COURSES
(Assumes 6 students, 1 classroom set,
no hardware costs included)

	Alaska History	English	Math	Reading
Price Per Course FY81	$ 503	$ 235	$ 276	$ 236
Price Per Course FY82	528	263	304	264

FY81 Price Per site For Two Courses

Alaska History	738	779	739
English		511	471
Math			512

FY81 Price Per Site For Three Courses

English & Alaska History	1014	974
Math & Alaska History		1015
English & Math		747

FY81 Price per site for 4 courses: $1250

FY82 Price per site for 4 courses: $1359

TABLE 4

COST PER SITE FOR FY81 FROM COST MODEL IN FIGURE 4

FOR ONE, TWO, THREE, AND FOUR COURSES*

(In Dollars)

NUMBER OF COURSES	HIGHEST**	LOWEST**
One	2781 (Alaska History)	2513 (English)
Two	3057 (Alaska History, Math)	2749 (English, Reading)
Three	3293 (Alaska History, Math, Reading)	3025 (Math, Reading, English)
Four	3528 (Alaska History, Reading, Math, English)	3528

* Assumes one set of hardware, and 6 students per site.

** Highest costs are for Alaska History, and lowest for English.

TABLE 5

TOTAL COSTS OF IST PROGRAM PER STUDENT

ENROLLED FOR FY81 (BASED ON FIGURES 3, 4, 5)

(nearest whole $)

		COST TO DOE		COST TO SITE		TOTAL	
	(n) NUMBER ENROLLED	(a) TOTAL	(b) PER STUDENT	(c) TOTAL	(d) PER STUDENT	a + c	b + d
1. For Printed Portion Alone							
Alaska History	75	62,456	833	8,017	107	70,473	940
English	59	55,789	946	3,830	65	59,619	1,011
General Math	117	57,456	491	8,624	74	60,080	565
Developmental Reading	116	57,456	495	7,646	66	65,102	561
2. For Print Plus Audio							
Alaska History	75	73,074	974	9,453	126	82,527	1,100
English	59	65,273	1106	4,548	77	69,821	1,183
General Math	117	67,224	575	10,152	87	77,376	662
Developmental Reading	116	67,224	580	9,020	78	76,243	658
3. For Complete Course (Print, Audio, and Computer)							
Alaska History	75	131,294	1,751	15,150	202	146,444	1,953
English	59	119,592	2,027	7,677	130	127,269	2,157
General Math	117	122,519	1,047	16,492	141	139,011	1,188
Developmental Reading	116	122,519	1,056	14,787	127	137,306	1,083

TABLE 6

TOTAL COSTS OF IST PROGRAM PER STUDENT

ENROLLED FOR 600 STUDENTS (USING FIGURES 3, 4, 5)

(100 SITES WITH 600 STUDENTS BASED ON FY81 COSTS)

	COST TO DOE		COST TO SITE		TOTALS	
	TOTAL (a)	PER STUDENT (b)	TOTAL (c)	PER STUDENT (d)	a + c	b + d
1. For Printed Portion Alone						
Alaska History	62,456	104	86,566	144	149,022	248
English	55,789	93	59,700	100	115,489	193
General Math	57,456	96	63,800	106	121,256	202
Developmental Reading	57,456	96	66,140	110	123,596	206
2. For Print Plus Audio						
Alaska History	73,074	122	101,355	169	174,429	291
English	65,273	109	69,916	117	135,189	226
General Math	67,224	112	74,719	125	141,943	237
Developmental Reading	67,224	112	77,446	129	144,670	241
3. For Complete Course (Print, Audio, and Computer)						
Alaska History	131,294	219	155,678	259	286,972	478
English	119,592	199	109,515	182	229,107	382
General Math	122,519	204	116,723	195	239,242	399
Developmental Reading	122,519	204	120,814	201	243,333	405

State Department of Education Costs

Local Level - School or District Costs

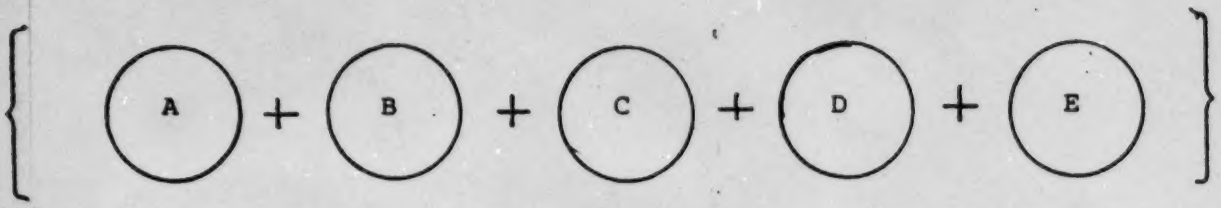
A = Continuing costs (e.g., management, salaries, supplies, etc.)

B = Annualized one-time costs (e.g., equipment, materials development, etc.)

C = Continuing costs (e.g., supervision, staff, supplies, etc.)

D = Annualized one-time costs (e.g., equipment, staff training, texts, etc.)

Figure 1. Overall costs for one year of an educational program.



A = Management, supervision, administration costs

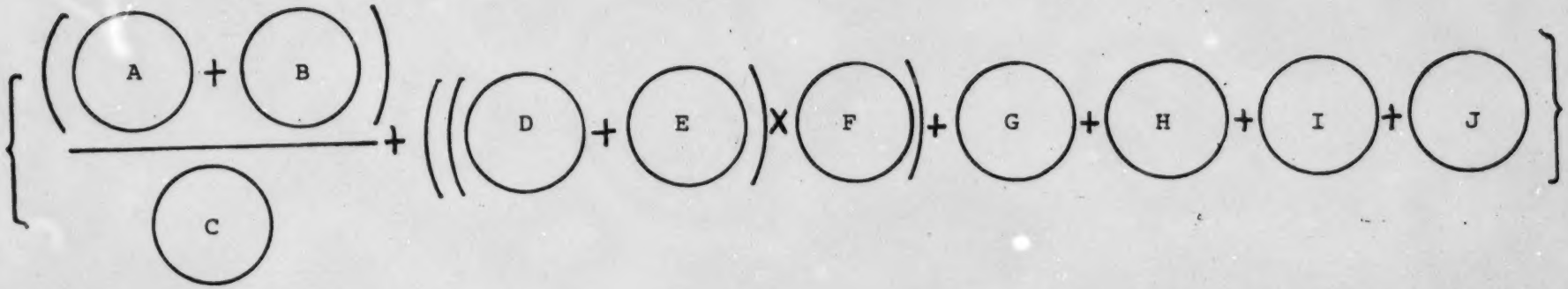
B = Staff training costs

C = Development costs

D = Production

E = Equipment support (e.g., subsidy to local district, maintenance service, etc.)

Figure 2. Simplified State Department of Education cost model for implementation of computerized instruction for one year.



A = Annualized hardware costs

B = Maintenance costs

C = Number of courses using hardware

D = Cost per student set of materials (non-consumable)

E = Cost per student set of consumable supplies

F = Number of students enrolled

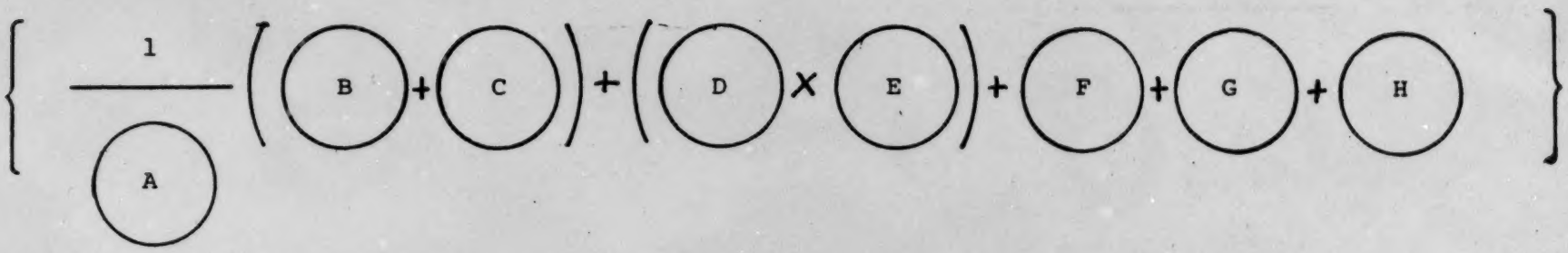
G = Cost of supplies (e.g., tapes, diskettes, etc.)

H = Teacher training costs (e.g., materials, travel, substitute teachers, etc.)

I = Cost of classroom sets (slide programs, computer programs, etc.) of non-consumable materials

J = Cost of classroom sets of consumable materials

Figure 3. Local school model for costs per course of individualized computerized instruction.



A = The number of courses offered at the site

B = Cost of hardware and equipment maintenance

C = Teacher training costs

D = Number of student registered

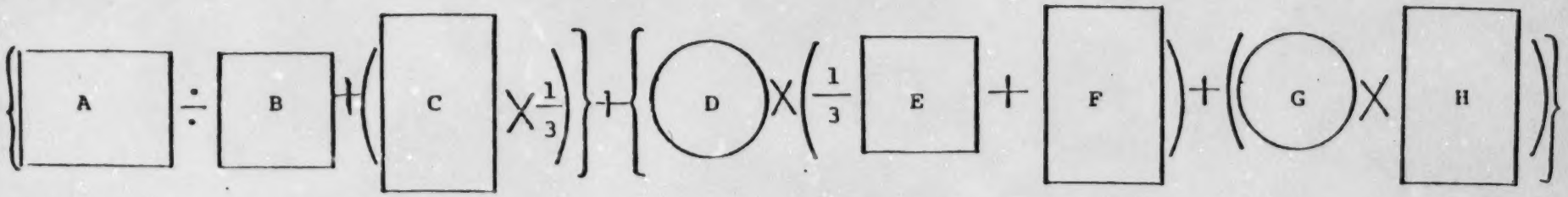
E = Cost per student set of materials

F = Cost of diskettes

G = Costs of classroom set of materials (non-consumable)

H = Costs of classroom set of consumable materials

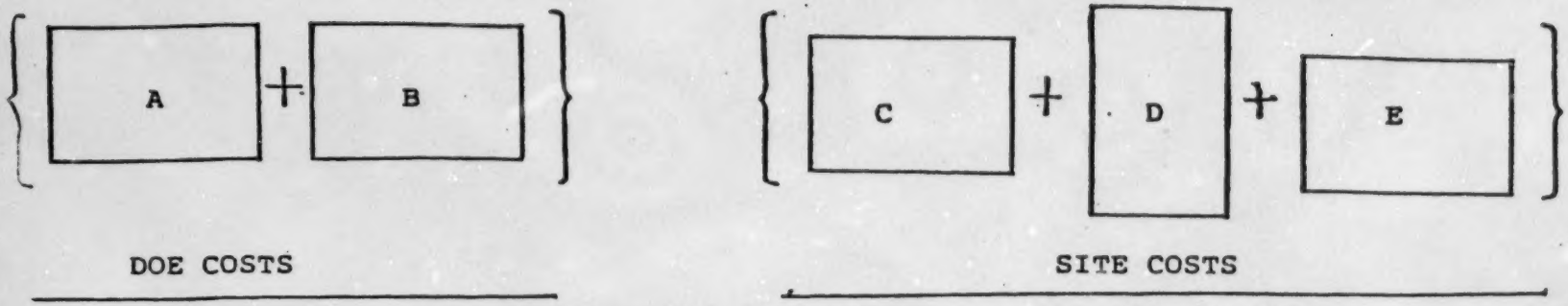
Figure 4. Model for computing local site costs for each IST course.



DOE COSTS — SITE COSTS

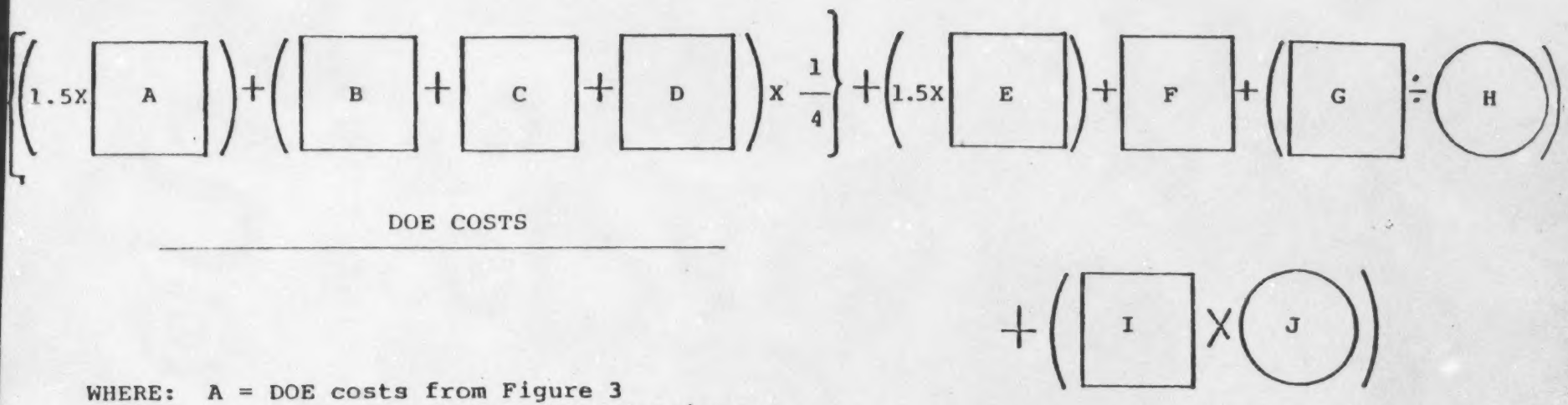
WHERE:
- A = All DOE costs excluding audio and computer component costs
- B = Number of courses (four in FY81)
- C = Development costs for each course (Alaska History, English, General Math, or Developmental Reading)
- D = Number of (Pilot) sites (in FY81)
- E = Cost of teacher training
- F = Cost of classroom sets
- G = Number of students enrolled
- H = Cost of student sets for each course used

Figure 5. Model for the total cost of printed component of an individual IST course.



WHERE:
- A: DOE costs from Figure 2 for each course
- B: .17 x A = Estimated cost of developing audio components for each course
- C: 1.17 x site costs for each course in Figure 2
- D: Amortized cost of tapes
- E: Amortized cost of tape recorder/player

Figure 6. Total cost of an IST course with audio component and print materials.



WHERE:
- A = DOE costs from Figure 3
- B = Hard and software consultation
- C = Version 1.0 + enhancement
- D = Diskette costs
- E = Site costs from Figure 3
- F = Diskette costs
- G = Computer hardware costs
- H = Average number of IST courses per site (for FY81 = 2.8)
- I = Cost of additional diskettes
- J = Number of students enrolled x 2

Figure 7. Cost model for a complete IST course for FY81.

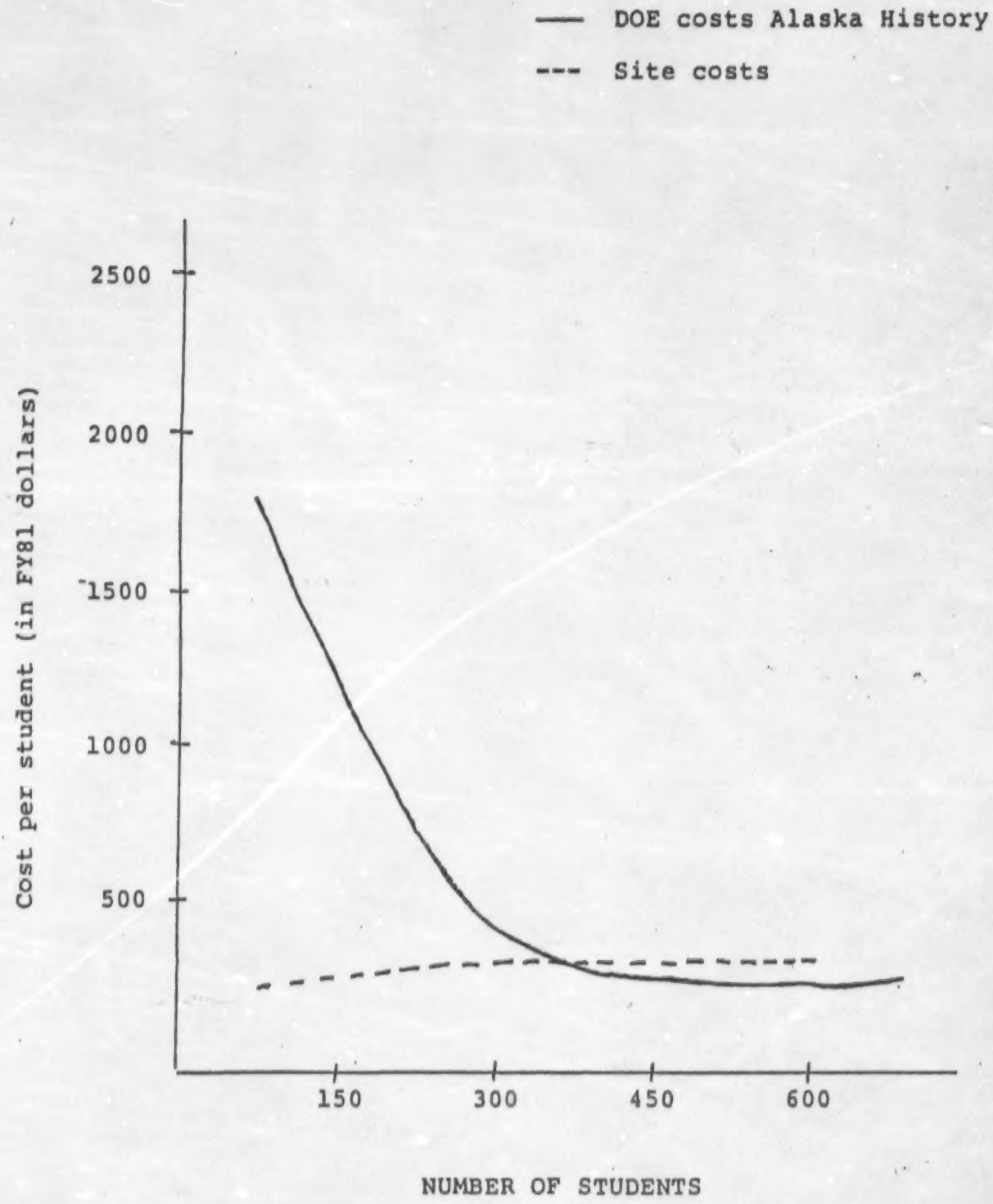


Figure 8. Comparison of effects on DOE and Site costs of increasing student participation in IST Alaska History course.